

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
12 December 2002 (12.12.2002)

PCT

(10) International Publication Number  
**WO 02/098707 A1**

(51) International Patent Classification<sup>7</sup>: **B60R 13/08**

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(21) International Application Number: PCT/US02/16691

(22) International Filing Date: 28 May 2002 (28.05.2002)

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
60/295,432 1 June 2001 (01.06.2001) US

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(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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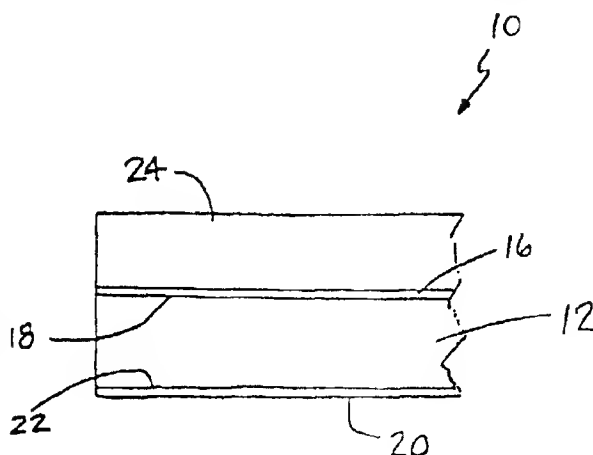
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Published:

— with international search report

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: UNDER CARPET HEAT SHIELD AND FLOOR PAN INSULATOR



(57) Abstract: An under carpet heat shield/floor pan insulator (10) is provided for a vehicle. The shield/insulator includes an acoustical and thermal insulating layer of polymer fiber (12) that shows no signs of any thickness increase, delamination, deterioration or any undesirable effect which may affect performance for at least 330 hours when maintained at a temperature of at least approximately 150°C (302°F). The shield/insulator may include a relatively high density, nonlaminated skin of polymer fiber (14) and/or one or more facing layers constructed from polymer material (16, 20).

WO 02/098707 A1

UNDER CARPET HEAT SHIELD  
AND FLOOR PAN INSULATOR

TECHNICAL FIELD AND INDUSTRIAL

5    APPLICABILITY OF THE INVENTION

The present invention relates generally to the field of acoustical and thermal insulation and, more particularly, to an under carpet shield and floor pan insulator for a vehicle.

10   BACKGROUND OF THE INVENTION

Acoustical and thermal insulators and liners for application to vehicles are well known in the art. These insulators typically rely upon both sound absorption, that is, the ability to absorb incident sound waves and transmission loss, that is, the ability to reflect incident sound waves, in order to provide sound attenuation. They also rely upon thermal  
15   shielding properties to prevent or reduce the transmission of heat from various heat sources (for example, engine, transmission and exhaust system), to the passenger compartment of the vehicle. Such insulation is commonly employed as an under carpet heat shield and a floor pan insulator.

Examples of acoustical and thermal insulation in the form of liners are disclosed in  
20   a number of prior art patents including U.S. Patents 4,851,283 to Holtrop et al. and 6,008,149 to Copperwheat. As should be apparent from a review of these two patents, engineers have generally found it necessary to construct such liners from a laminate incorporating (a) one or more layers to provide the desired acoustical and thermal insulating properties and (b) one or more additional layers to provide some rigidity to  
25   allow ease of handling during installation.

U. S. Patents 6,092,622 to Hiers et al. and 6,123,172 to Byrd et al. disclose needled composite thermal and acoustical insulators containing various layers of polymer fibers, glass fibers, metallic foils, scrims and other facings. The metallic foil facing is secured in place with an adhesive. The needling construction of the batt requires perforating the  
30   interior insulating layer, thereby providing numerous passageways for the passage of both heat and sound.

While a number of adhesives, adhesive webs and binding fibers have been specifically developed over the years to secure the various layers of the laminates together,

laminated shields and insulators have an inherent risk of delamination and failure. The potential is, in fact, significant mainly due to the harsh operating environment to which the shields and insulators are subjected. Many shields and insulators are located near and/or are designed to shield high heat sources such as the engine, transmission and exhaust system. As a result, the shields and insulators are often subjected to temperatures in excess of 93°C (200°F) which have a tendency to degrade the adhesives and binders over time.

Shields and insulators used for under carpet and floor pan applications also carry foot traffic and thus are subjected to repeated compression and decompression. This activity places very significant strain on the shields and insulators, often resulting in adhesive failure and delamination of the shield or insulator over time.

A need is therefore identified for an under carpet heat shield/floor pan insulator incorporating a nonlaminated acoustical and thermal insulating layer of polymer fibers suitable for use in the proximity of high temperature heat sources such as an exhaust system and particularly a catalytic converter and capable of providing the desired acoustical and thermal insulating properties. Advantageously, such an insulator also provides the desired mechanical strength and rigidity to allow simple and convenient installation while also providing a long service life characterized by reliable performance.

## SUMMARY OF THE INVENTION

Accordingly, it is a primary object of the present invention to provide an under carpet heat shield/floor pan insulator for a vehicle. That shield/insulator comprises a single, nonlaminated acoustical and thermal insulating layer of polymer fiber selected from a group consisting of polyester, polypropylene, polyethylene, rayon, nylon and any mixtures thereof. The thermal insulating layer is preferably a nonwoven fabric and may further include additional fibers selected from a group consisting of glass fibers and natural fibers to meet the specific performance requirements of a particular application.

In accordance with one aspect of the present invention the acoustical and thermal insulating layer may include a relatively high density, non-laminated skin of polymer fiber along at least one face thereof. Still further, the insulator may include a first metal foil facing layer over a first face of the acoustical and thermal insulating layer. Similarly, a second metal foil facing layer may be provided over a second face of the acoustical and thermal insulating layer.

Figure 5, the shield or insulator 10 comprises a single, nonlaminated acoustical and thermal insulating layer 12 of polymer fiber (for example, a nonwoven fabric) as described above in combination with a first metal foil facing 16 covering a first face thereof and a second metal foil facing 20 covering a second face 22 thereof. Additionally, the shield or insulator 10 of this embodiment includes an additional acoustical and thermal insulating layer 24 of polymer fiber (for example, a nonwoven fabric) selected from a group consisting of polyester, polypropylene, polyethylene, rayon, nylon and any mixtures thereof. As a result, the first metal foil facing layer 16 is sandwiched between the two acoustical and thermal insulating layers 12, 24.

10 In any of the embodiments described above and illustrated in Figures 1-5, the acoustical and thermal insulating layer 12 and or 24 may further include from about 10 - 60 weight percent of glass and/or natural fibers such as, but not limited to E-glass, S-glass, kenaf, hemp and mixtures thereof. Use of such glass and natural fibers may be desirable to meet the performance parameters necessary for some potential applications.

15 In summary, numerous benefits result from employing the concepts of the present invention. An under carpet heat shield or floor pan insulator 10 constructed in accordance with the teachings of the present invention provides a unique combination of mechanical strength and rigidity as well as thermal and acoustical properties which are consistently and reliably maintained over a long service life even in the proximity of a high temperature heat source such as a catalytic converter. In one of the embodiments of the present invention, a relatively high density, nonlaminated skin is provided which aids in handling, is aesthetically pleasing and maintains the full recyclability of the shield or insulator.

25 The foregoing description of a preferred embodiment of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Obvious modifications or variations are possible in light of the above teachings. For example, the shield or insulator 10 could include a relatively high density nonlaminated skin 14 on both opposing faces and/or along the edges of the shield or insulator. Additionally, a shield or insulator 10 with one or more high density, nonlaminated skins 14 could also include one or more facings 16, 20 if required to meet acoustical, thermal, structural and/or aesthetic performance requirements of a particular application.

The embodiment was chosen and described to provide the best illustration of the

principles of the invention and its practical application to thereby enable one of ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims  
5 when interpreted in accordance with the breadth to which they are fairly, legally and equitably entitled.

## WHAT IS CLAIMED IS:

1. An under carpet heat shield/floor pan insulator (10) for a vehicle,  
comprising:  
a nonlamineate acoustical and thermal insulating layer of polymer fiber (12)  
5 selected from a group consisting of polyester, polypropylene, polyethylene, rayon, nylon  
and any mixtures thereof.
2. The shield/insulator of claim 1, wherein said acoustical and thermal  
insulating layer is a nonwoven fabric.
3. The shield/insulator of claim 1, wherein said acoustical and thermal  
10 insulating layer further includes additional fibers selected from a group consisting of glass  
fibers and natural fibers.
4. The shield/insulator of claim 1, including a relatively high density,  
nonlamineate skin of polymer fiber (14) along at least one face of said acoustical and  
thermal insulating layer.
- 15 5. The shield/insulator of claim 1, including a first metal foil facing layer (16)  
over a first face (18) of said acoustical and thermal insulating layer.
6. The shield/insulator of claim 5, including a second metal foil facing layer  
(20) over a second face (22) of said acoustical and thermal insulating layer.
7. The shield/insulator of claim 6, including an additional acoustical and  
20 thermal insulating layer of polymer fiber (24) selected from a group consisting of  
polyester, polypropylene, polyethylene, rayon, nylon and any mixtures thereof over said  
first metal foil facing layer wherein said first metal foil facing layer is sandwiched  
between said additional acoustical and thermal insulating layer and said acoustical and  
thermal insulating layer.
- 25 8. An under carpet heat shield/floor pan insulator (10) for a vehicle,  
comprising:  
a nonlamineate acoustical and thermal insulating layer (12) of substantially  
100% polyethylene terephthalate nonwoven fabric.
9. The shield/insulator of claim 8, including a relatively high density skin (14)  
30 along at least one face thereof.
10. The shield/insulator of claim 8, including a first metal foil facing layer (16)  
over a first face (18) of said acoustical and thermal insulating layer.
11. The shield/insulator of claim 10, including a second metal foil facing layer

(20) over a second face (22) of said acoustical and thermal insulating layer.

12. The shield/insulator of claim 11, including an additional acoustical and thermal insulating layer of polymer fiber (24) selected from a group consisting of polyester, polypropylene, polyethylene, rayon, nylon and any mixtures thereof over said first metal foil layer wherein said first metal foil layer is sandwiched between said additional acoustical and thermal insulating layer and said acoustical and thermal insulating layer.

13. An under carpet heat shield/floor pan insulator (10) for a vehicle, comprising:  
a nonlamine acoustical and thermal insulating layer of polymer fiber (12) selected from a group consisting of polyester, polypropylene, polyethylene, rayon, nylon and any mixtures thereof that shows no signs of any thickness increase, delamination, deterioration or any undesirable effect which may affect performance for at least 330 hours at 150°C (302°F).

14. The shield/insulator of claim 13, wherein said acoustical and thermal insulating layer is a nonwoven fabric.

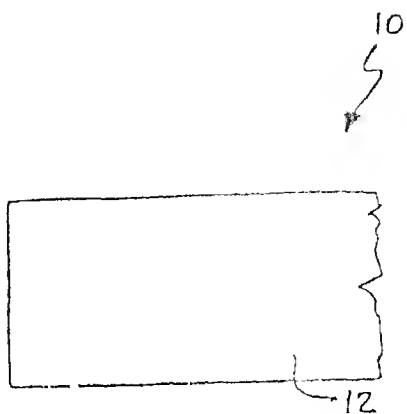


Fig. 1

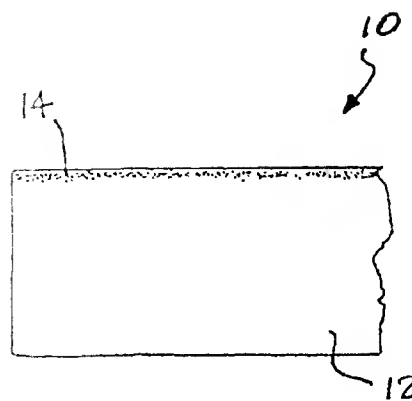


Fig. 2

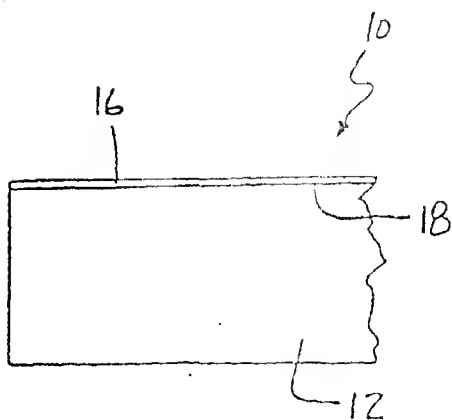


Fig. 3

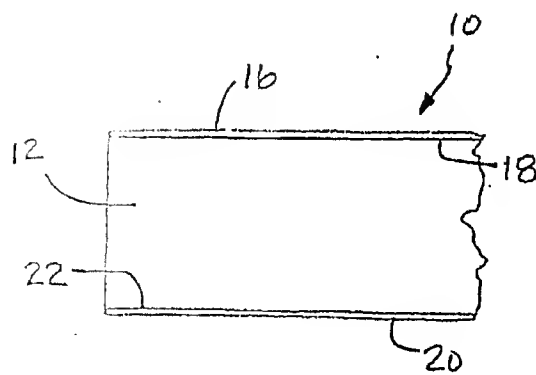


Fig. 4



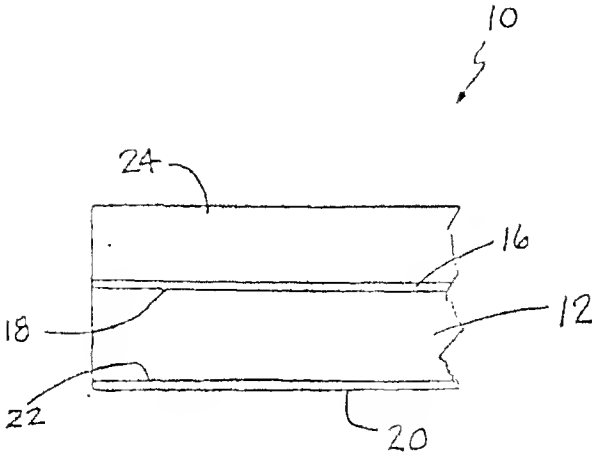


Fig. 5

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 02/16691

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 B60R13/08

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B60R G10K F02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 13, 30 November 1998 (1998-11-30) -& JP 10 228285 A (TOYODA GOSEI CO LTD), 25 August 1998 (1998-08-25) paragraph '0001! - paragraph '0017!	1,2,4,8, 9,13,14
X	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 05, 31 May 1999 (1999-05-31) & JP 11 034760 A (KASAI KOGYO CO LTD), 9 February 1999 (1999-02-09) abstract  --- -/--	1,4,8,9, 13

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

## \* Special categories of cited documents:

\*A\* document defining the general state of the art which is not considered to be of particular relevance

\*E\* earlier document but published on or after the international filing date

\*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

\*O\* document referring to an oral disclosure, use, exhibition or other means

\*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*Z\* document member of the same patent family

Date of the actual completion of the international search

12 September 2002

Date of mailing of the international search report

20/09/2002

Name and mailing address of the ISA

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## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 02/16691

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 123 172 A (BYRD TIMOTHY L ET AL) 26 September 2000 (2000-09-26) cited in the application column 10, line 35 -column 12, line 26; figures 6-8 -----	1-14

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 02/16691

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 10228285	A	25-08-1998	NONE
JP 11034760	A	09-02-1999	NONE
US 6123172	A	26-09-2000	AU 6490200 A 13-02-2001
		BR 0012643 A 09-04-2002	
		EP 1203126 A1 08-05-2002	
		WO 0107726 A1 01-02-2001	

More specifically describing the invention, the under carpet heat shield and floor pan insulator of the present invention may comprise a single nonlamine acoustical and thermal insulating layer of polymer fiber selected from a group consisting of polyester, polypropylene, polyethylene, rayon, nylon and any mixtures thereof that shows no signs of any thickness increase, delamination, deterioration or any undesirable effect which may affect performance when subjected to a temperature of about 150°C (302°F) for a period of at least 330 hours. Still more specifically describing the invention, the shield/insulator may comprise a nonlamine acoustical and thermal insulating layer of substantially 100% polyethylene terephthalate.

The benefits and advantages of the present invention will become readily apparent to those skilled in this art from the following description wherein there is shown and described several preferred embodiments of this invention, simply by way of illustration of some of the modes best suited to carry out the invention. As it will be realized, the invention is capable of still other different embodiments and its several details are capable of modification in various, obvious aspects all without departing from the invention. Accordingly, the drawing and descriptions will be regarded as illustrative in nature and not as restrictive.

#### BRIEF DESCRIPTION OF THE DRAWING

The accompanying drawing incorporated in and forming a part of the specification, illustrates several aspects of the present invention, and together with the description serves to explain the principles of the invention. In the drawing:

Figure 1 is a schematical side elevational view of one possible embodiment of the present invention; and

Figures 2-5 are schematical side elevational illustrations of other possible alternative embodiments of the present invention.

Reference will now be made in detail to the present preferred embodiment of the invention, an example of which is illustrated in the accompanying drawing.

#### DETAILED DESCRIPTION OF THE INVENTION

Reference is now made to Figure 1 showing a first embodiment of the under carpet heat shield and floor pan insulator 10 of the present invention. The shield or insulator 10 comprises an acoustical and thermal insulating layer 12 of polymer fiber. More

specifically, a single, nonlaminated layer 12 is provided with the necessary mechanical strength and rigidity to allow easy installation and the desired acoustical and thermal insulating properties. Advantageously, all of these benefits are achieved in a light weight insulator 10 which may even be used in compact vehicles where fuel economy concerns lead manufacturers to seek weight savings wherever possible.

The polymer fiber is not foamed and typically is a nonwoven fabric. The polymer fiber may be selected from a group of fibers consisting of polyester, polypropylene, polyethylene, rayon, nylon and any mixtures thereof. The acoustical and thermal insulating layer 12 is engineered to show no signs of any thickness increase, delamination, deterioration or any undesirable effect which may affect performance when subjected to a temperature of approximately 150°C (302°F) for a period of at least 330 hours. Advantageously, such a shield or insulator 10 has a weight of between about 40-130 g/ft<sup>2</sup>. For example, the acoustical and thermal insulating layer 12 may comprise substantially 100% polyethylene terephthalate.

A shield or insulator 10 made from 100% polyethylene terephthalate provides a number of advantages when compared to a state of the art shield made from a layer of glass fibers sandwiched between layers of polyester. The shield or insulator 10 of the present invention may be cut with a heat knife to give an edge. The shield or insulator 10 of the present invention can be premolded to accommodate different shapes and sizes and will eventually mold to the cavity size even when the cavity is uneven. The state of the art shield cannot shape adapt to the mounting cavity in the bodywork or framework of the vehicle in a like manner.

Further, where the shield or insulator 10 of the present invention is dimensionally stable upon exposure to temperatures up to 232°C (450°F) at which slight yellowing may occur, the state of the art shield tends to disfigure and the phenolic binder is released, resulting in the production of an odor and browning of the shield. Of course, the shield or insulator 10 of the present invention is also free of glass fiber and, therefore, is installer friendly ( does not produce an itchy feeling for those contacting the material). While the glass fiber in the state of the art product is sandwiched between two layers of polyester, the product still tends to be more irritating to those coming into contact with it. Accordingly, for many applications it is necessary to cut the edge of the shield or insulator in order to avoid this potential irritation.

In a first alternative embodiment shown in Figure 2, the shield or insulator 10 also

comprises a nonlamine acoustical and thermal insulating layer 12 of polymer fiber (for example, a nonwoven fabric) selected from a group consisting of polyester, polypropylene, polyethylene, rayon, nylon and any mixtures thereof. The layer 12 also includes a relatively high density, nonlamine or unitary skin 14 of that polymer fiber  
5 along at least one face thereof.

Advantageously, the high density skin 14 will not delaminate from the layer 12 under the environmental conditions existing under the carpet and along the floor pan of the vehicle and also adds structural integrity and strength to the shield or insulator 10 which aids significantly in handling and fitting the part during installation. The high density skin  
10 14 is also more aesthetically pleasing. Still further, for many applications the high density skin 14 eliminates the need to provide an additional facing layer of another type of material. This serves to eliminate any potential failure of the shield or insulator due to delamination. It also results in a shield or insulator made exclusively from one material that is, therefore, readily recyclable. Further, since the skin may be formed with a hot  
15 platen during the molding of the shield or insulator 10 to its desired shape, no additional processing step is required. This reduces production cost relative to a shield or insulator with a facing since such a facing must be adhered to the acoustical and thermal insulating layer in a separate processing step.

In yet another embodiment shown in Figure 2, the shield or insulator 10 includes a  
20 nonlamine acoustical and thermal insulating layer of polymer fiber 12 (for example, a nonwoven fabric) selected from a group consisting of polyester, polypropylene, polyethylene, rayon, nylon and any mixtures thereof in combination with a metal foil facing layer 16 over a first face 18 of the acoustical and thermal insulating layer. The metal foil facing may be present in one or more layers.

In yet another alternative embodiment shown in Figure 4, the shield or insulator 10 comprises a nonlamine acoustical and thermal insulating layer 12 of polymer fiber as described above in combination with a first metal foil facing layer 16 covering a first face 18 thereof and a second metal foil facing layer 20 covering a second, opposite face 22 thereof. The second facing layer 20 may be constructed from the same or a different  
30 material as the first facing layer 16. The first and second facing layers 16, 20 may be attached to the layer 12 by means of an appropriate adhesive or adhesive web in accordance with practices well known to those skilled in the art.

In accordance with yet another embodiment of the present invention shown in